# CompassCDS
# National Instruments NI-9481 Relay & NI-9401 TTL I/O Module User Guide

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# Introduction

The National Instruments NI-9181 single slot chassis can be used in conjunction with the NI-9481 Relay module or the NI-9401 TTL I/O module to facilitate triggering of external devices and instruments such as valves and autosamplers etc. within the CompassCDS software as well as for triggering of the CompassCDS software by external devices.

The standard 4 channel relay interface module configuration for CompassCDS (part number BR502096) includes the NI-9181 single-slot Ethernet chassis and power supply as well as the 4 Channel, 30-60VDC, 250 VAC NI-9481 Relay Module and terminal connector kit shown below.

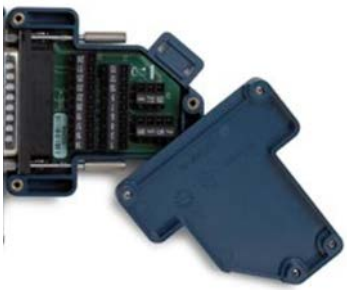
*NI-9181*

*NI-9481*

The standard TTL I/O interface module configuration for CompassCDS (part number BR502098) includes the NI-9181 single-slot Ethernet chassis and power supply as well as a NI-9401 8 Channel TTL Digital Input/Output module and terminal connector kit shown below.

*NI-9181*

*NI-9401 TTL I/O*

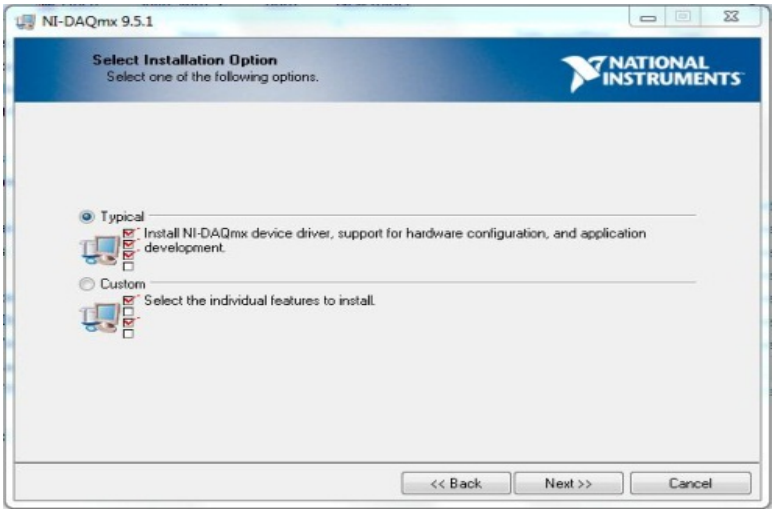


*NI-9924*

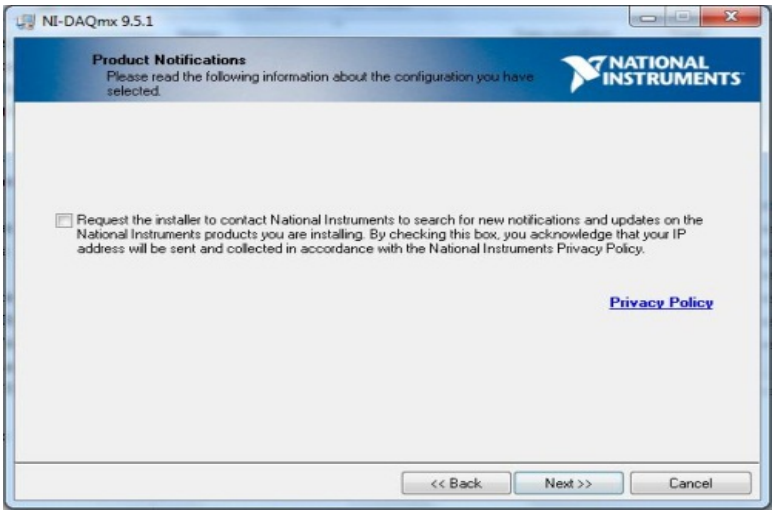
# NI-DAQmx Software Installation

The National Instruments NI-DAQmx software is required to be installed in order to a) configure the NI-9181 Chassis and b) operate the NI-9481 Relay and NI-9401 TTL I/O modules. This software is supplied on a CD with the NI-9181 Chassis and can also be downloaded from the National Instruments website [www.nationalinstruments.com](http://www.nationalinstruments.com)

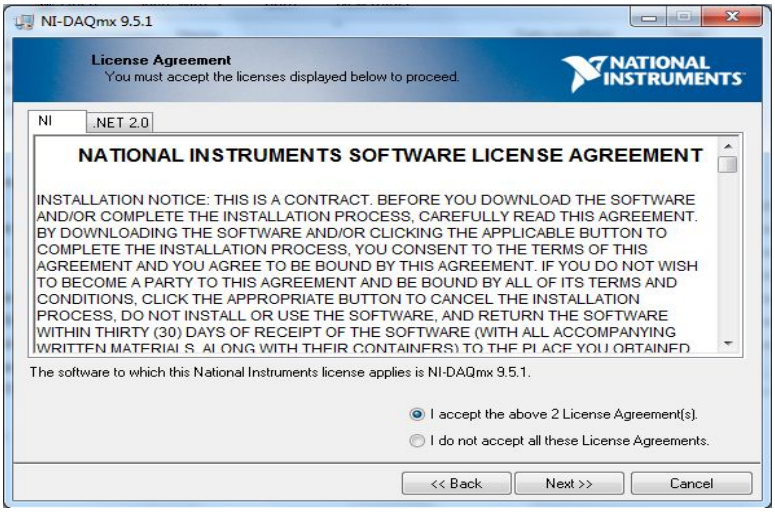
Insert the CD into appropriate drive on the computer and the autorun will prompt the installer to select either a Typical or Custom installation. The Typical installation option should be selected and Next clicked.



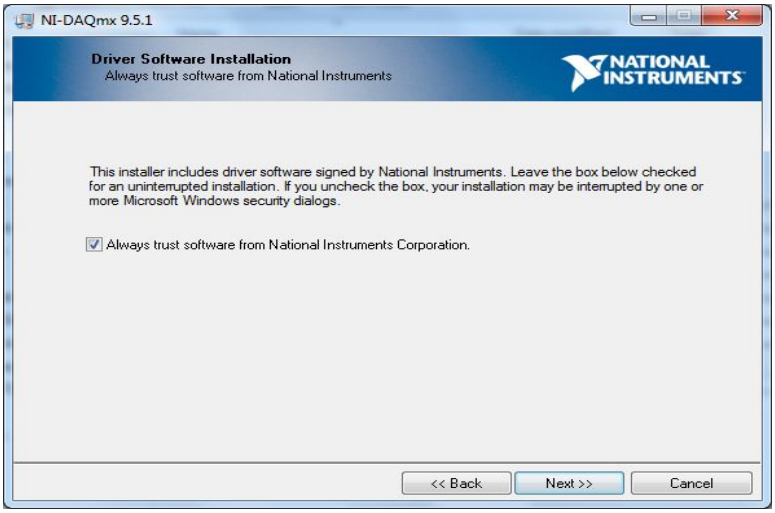

Do not check the “Request the installer to contact National Instruments”…. Box, simply click Next


NI-DAQmx 9.5.1
Product Notifications
Please read the following information about the configuration you have selected.
NATIONAL INSTRUMENTS
Request the installer to contact National Instruments to search for new notifications and updates on the National Instruments products you are installing. By checking this box, you acknowledge that your IP address will be sent and collected in accordance with the National Instruments Privacy Policy.
Privacy Policy
<< Back
Next >>
Cancel

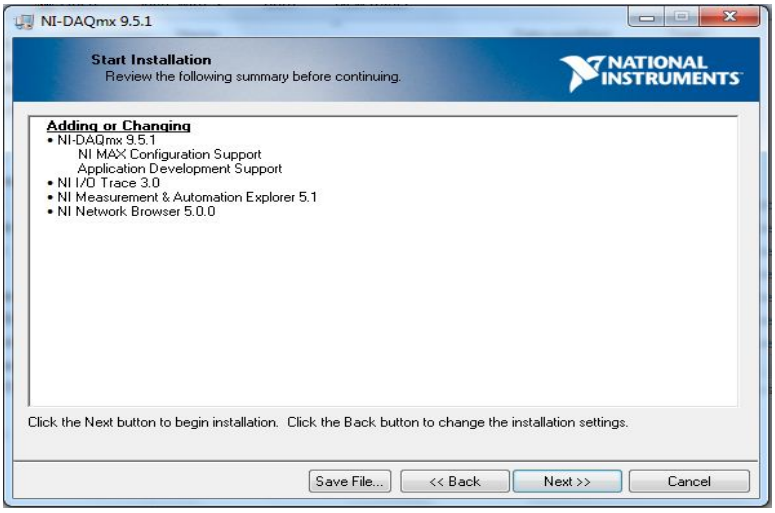
The installer should read the National Instruments software license agreement and then accept the 2 licenses by checking the radio button before clicking the Next option as shown below.


NI-DAQmx 9.5.1
License Agreement
You must accept the licenses displayed below to proceed.
NATIONAL INSTRUMENTS
NI
.NET 2.0
NATIONAL INSTRUMENTS SOFTWARE LICENSE AGREEMENT
INSTALLATION NOTICE: THIS IS A CONTRACT. BEFORE YOU DOWNLOAD THE SOFTWARE AND/OR COMPLETE THE INSTALLATION PROCESS, CAREFULLY READ THIS AGREEMENT. BY DOWNLOADING THE SOFTWARE AND/OR CLICKING THE APPLICABLE BUTTON TO COMPLETE THE INSTALLATION PROCESS, YOU CONSENT TO THE TERMS OF THIS AGREEMENT AND YOU AGREE TO BE BOUND BY THIS AGREEMENT. IF YOU DO NOT WISH TO BECOME A PARTY TO THIS AGREEMENT AND BE BOUND BY ALL OF ITS TERMS AND CONDITIONS, CLICK THE APPROPRIATE BUTTON TO CANCEL THE INSTALLATION PROCESS, DO NOT INSTALL OR USE THE SOFTWARE, AND RETURN THE SOFTWARE WITHIN THIRTY (30) DAYS OF RECEIPT OF THE SOFTWARE (WITH ALL ACCOMPANYING WRITTEN MATERIALS, ALONG WITH THEIR CONTAINERS) TO THE PLACE YOU OBTAINED
The software to which this National Instruments license applies is NI-DAQmx 9.5.1.
I accept the above 2 License Agreement(s).
I do not accept all these License Agreements.
<< Back
Next >>
Cancel

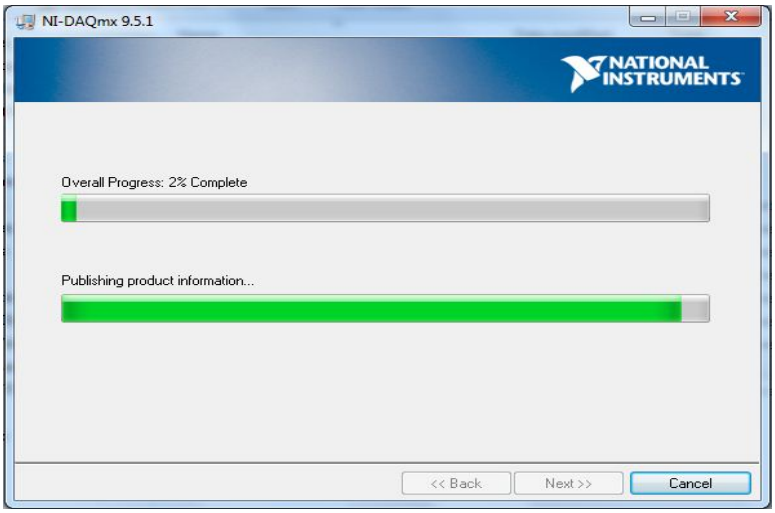
The installer should then check the “Always trust software from National Instruments Corporation checkbox and click the Next option as shown below.


NI-DAQmx 9.5.1
Driver Software Installation
Always trust software from National Instruments
NATIONAL INSTRUMENTS
This installer includes driver software signed by National Instruments. Leave the box below checked for an uninterrupted installation. If you uncheck the box, your installation may be interrupted by one or more Microsoft Windows security dialogs.
Always trust software from National Instruments Corporation.
<< Back
Next >>
Cancel

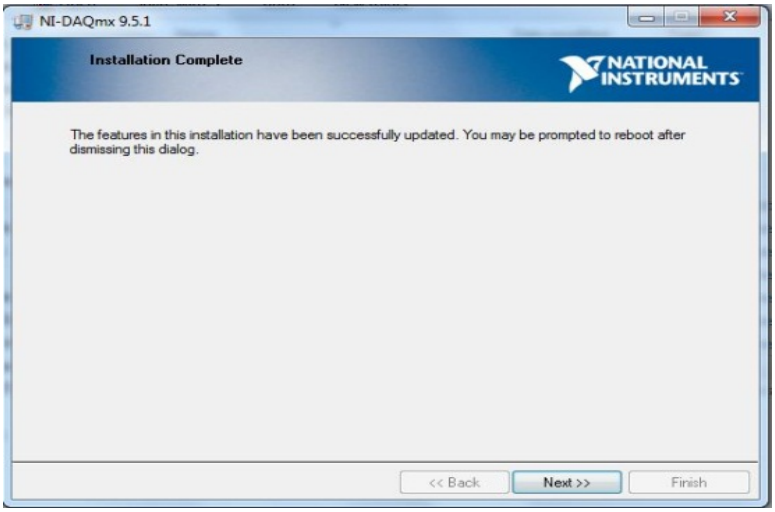
The installer should then click the Next button (see below) to start the installation of the NI-DAQmx software


NI-DAQmx 9.5.1
Start Installation
Review the following summary before continuing.
NATIONAL INSTRUMENTS
Adding or Changing
• NI-DAQmx 9.5.1
NI MAX Configuration Support
Application Development Support
• NI I/O Trace 3.0
• NI Measurement & Automation Explorer 5.1
• NI Network Browser 5.0.0
Click the Next button to begin installation. Click the Back button to change the installation settings.
Save File...
<< Back
Next >>
Cancel

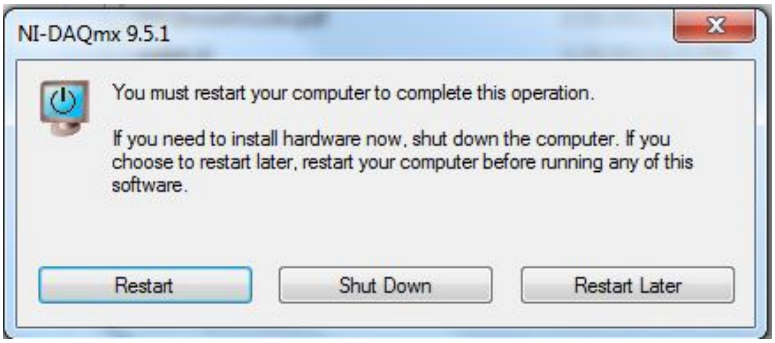
The NI-DAQmx software installation process can take some time and can be monitored by observing the Overall Progress bar as shown below.




When the installation completes, the installer will be prompted to reboot the computer and he/she should click the Next option.


NI-DAQmx 9.5.1
Installation Complete
NATIONAL INSTRUMENTS
The features in this installation have been successfully updated. You may be prompted to reboot after dismissing this dialog.
<< Back
Next >>
Finish

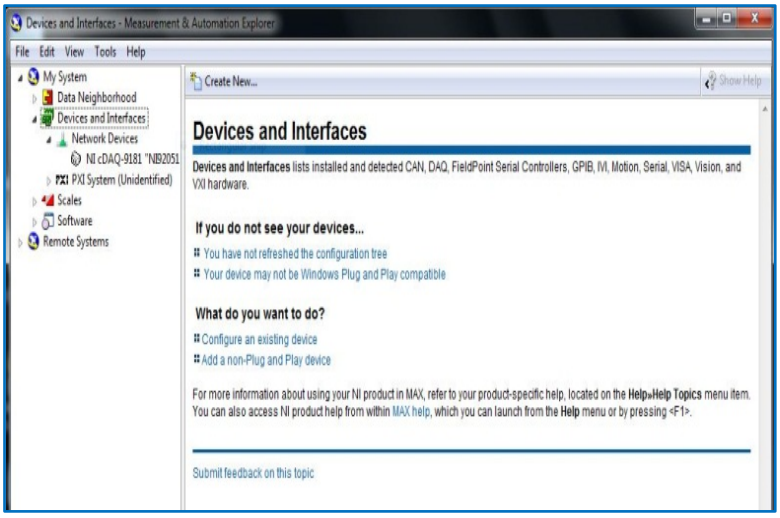
Click the Restart option and allow the computer to reboot.


NI-DAQmx 9.5.1
You must restart your computer to complete this operation.
If you need to install hardware now, shut down the computer. If you choose to restart later, restart your computer before running any of this software.
Restart
Shut Down
Restart Later

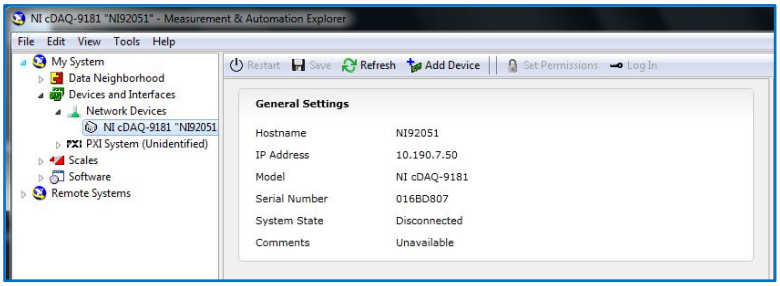
The NI-DAQmx software is now installed and can be used to configure the NI-9181 single-slot chassis and associated NI-9481 and NI-9401 modules as described below.

# NI-9181 Ethernet Chassis Configuration

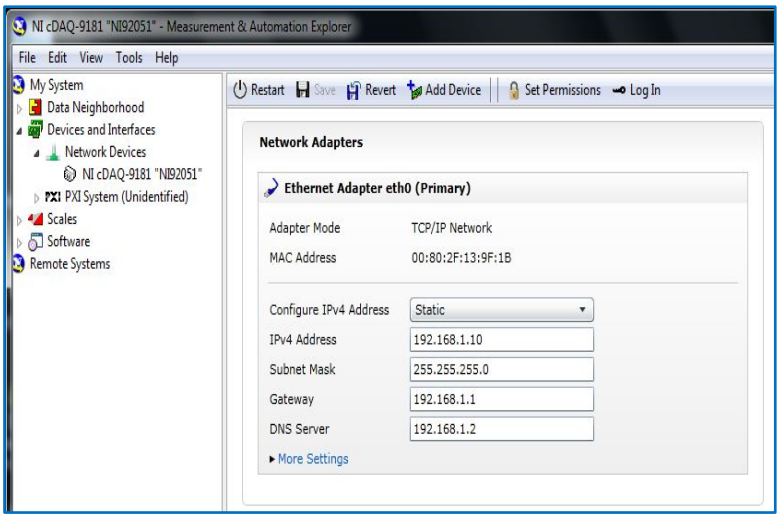
Before the NI-9181 single-slot chassis can be used with the CompassCDS software, it has to be assigned a unique name and a static IP address. The NI-9181 should be powered on and connected directly to the computer via an Ethernet crossover cable or indirectly via an Ethernet switch. The user launches the NI-DAQmx software from the desktop icon ( ) and selects the Devices and Interfaces, followed by the Network Devices option. The NI-9181 module should listed under Network Devices as shown below.


Devices and Interfaces - Measurement & Automation Explorer
File Edit View Tools Help
My System
Data Neighborhood
Devices and Interfaces
Network Devices
NI cDAQ-9181 "NI92051"
PXI System (Unidentified)
Scales
Software
Remote Systems
Create New...
Show Help
Devices and Interfaces
Devices and Interfaces lists installed and detected CAN, DAQ, FieldPoint Serial Controllers, GPIB, IVI, Motion, Serial, VISA, Vision, and VXI hardware.
If you do not see your devices...
You have not refreshed the configuration tree
Your device may not be Windows Plug and Play compatible
What do you want to do?
Configure an existing device
Add a non-Plug and Play device
For more information about using your NI product in MAX, refer to your product-specific help, located on the Help»Help Topics menu item. You can also access NI product help from within MAX help, which you can launch from the Help menu or by pressing <F1>.
Submit feedback on this topic

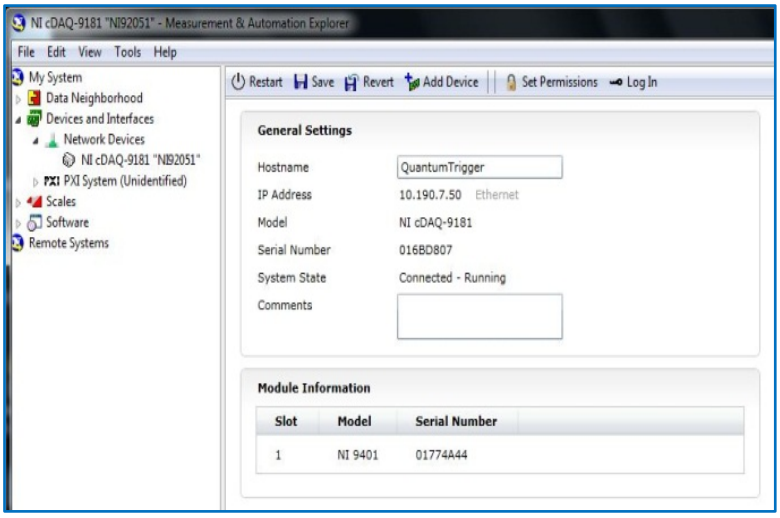
Select the NI-9181 module by clicking on it and the module settings will appear as shown below. The NI-9181 module requires a unique Hostname and IP Address




The IP Address can be changed by selecting the Settings tab. The assigned IP should be static, have a suitable Subnet Mask, Gateway IP and if required, a DNS server IP.

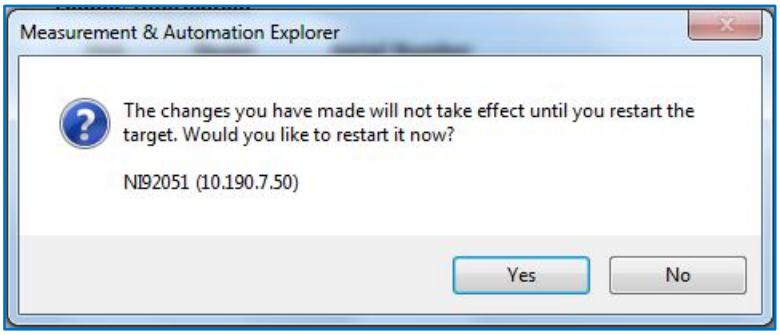



The Hostname can be changed from the General Settings tab. Once the IP and Hostname have been changed, it is necessary to click on the Save option to make these permanent.

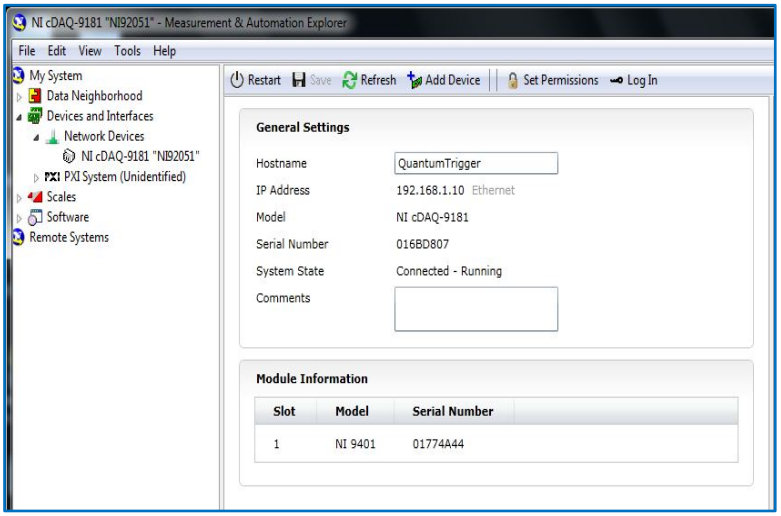



Restart the NI-9181 Chassis by clicking on the Restart option or by selecting the Yes option as shown below.

**Note:** the NI-9481 Relay or NI-9401 TTL I/O modules can be inserted into the NI-9181 module before the restart. The NI-9181 should be powered down before either of these modules is inserted.

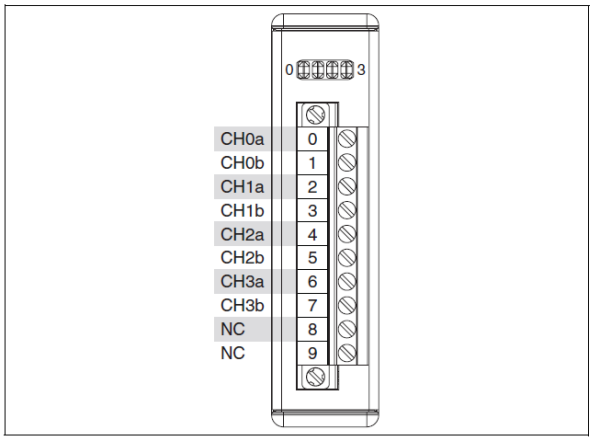

Measurement & Automation Explorer
The changes you have made will not take effect until you restart the target. Would you like to restart it now?
NI92051 (10.190.7.50)
Yes
No

Selecting the configured NI-9181 under Network Devices should display the new device Hostname and IP address. The inserted NI module (9481 or 9401) and its associated serial number should also now be visible in the Module Information section as shown below.

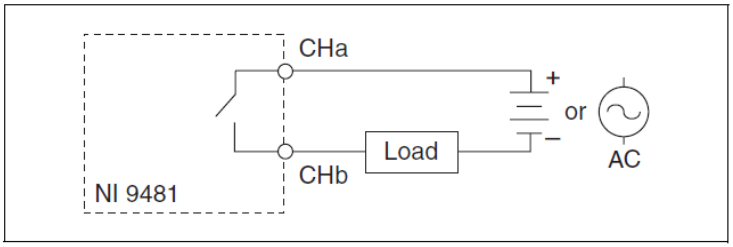


# Connecting the NI-9481 Relay Module

The NI-9481 has a 10-terminal detachable screw-terminal connector that provides connections for 4 electromechanical relay channels. Each electromechanical relay channel has two interchangeable terminals, CHa and CHb. Each channel has an LED that indicates the state of the channel. When a channel LED is lit, the channel is on i.e. the relay is closed. When the LED is un-lit, the channel is off and the relay is open.  Relay 1 is represented by CH0a and CH0b, i.e. screw terminals 0 & 1 as shown in the diagram below. Relay 2 is represented by CH1a and CH1b, i.e. screw terminals 2 & 3.



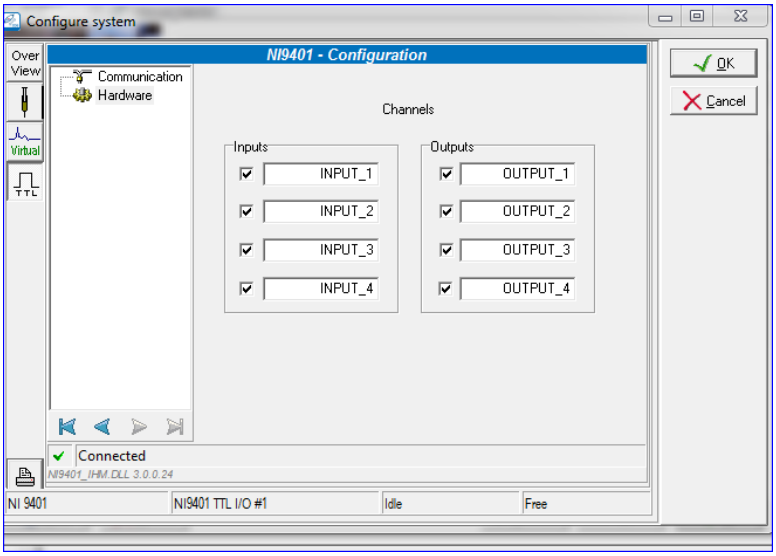

When connecting a load to the NI-9481, the positive lead of the load should be connected to either the CHa or the CHb terminal, and the ground of the load to one of the leads of the power supply. Connect the remaining CHa or CHb terminal to the other lead of the power supply. An example of this type of configuration is illustrated below.



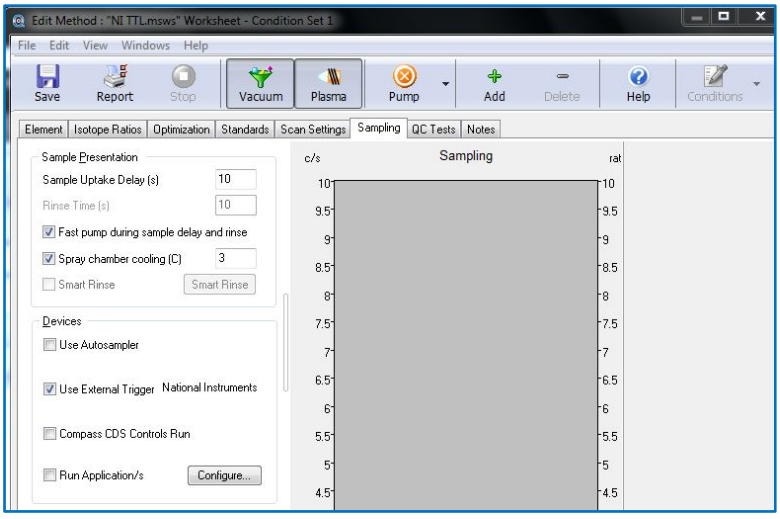
# Configuring the NI-9481 Relay Module in CompassCDS

The NI-9481 Relay module is configured from within the CompassCDS Configuration Manager. The relay module is usually added as part of an existing GC or LC system. Users select Systems, New, name the system and select the appropriate acquisition and sequence server from the dropdown list and click Next. A Group and Project(s) is selected and Next is clicked. The empty instrument device(s) installed dialog window appears and the user selects the 9181 and the 9481 control drivers as well as any other drivers required to build a GC or LC system before clicking Next.

The NI-9181 module IP address should be entered in the Address box and the Activate Communication button clicked. The Hostname will appear along with the 9481 graphical user interface (GUI) below the hostname. The Device Status should indicate *Connected***.** The relay timetable can be used to set up complex relay triggering if required.

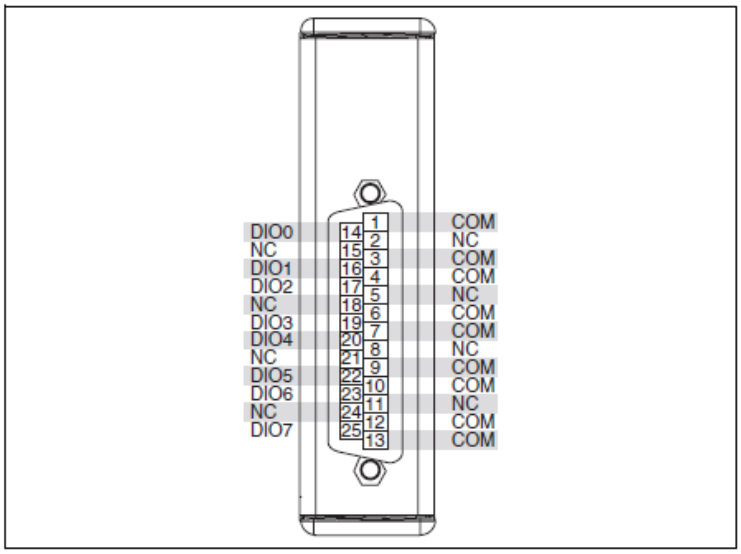



Once the relay device has been set up in Config Manager, the only additional setting is located within the CompassCDS method where the user must check the Use External Trigger checkbox as shown below. Once the method is saved, external triggering of the relay will be active.

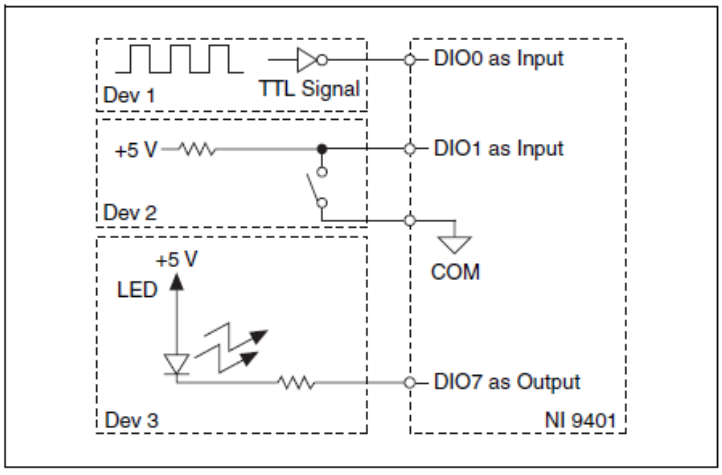


# Connecting the NI-9401 TTL I/O Module

The NI 9401 has a 25-pin DSUB connector that provides connections for eight digital input/output channels. Each channel has a Digital I/O (DIO) pin to which you can connect a digital input or output device. The eight DIO channels are internally referenced to COM, so you can use any of the nine COM lines as a reference for the external signal. The DIO channels are grouped in two ports, one containing channels 0, 1, 2, and 3, and one containing channels 4, 5, 6, and 7. It is possible to independently configure each digital port for input or output however all four channels in the port must share the same line direction. Each channel also has a pull-down resistor and includes overvoltage, overcurrent, and short-circuit protection. DIO0 or Channel 1 = screw terminals 14 & 1 is configured as an input channel in the CompassCDS software. DIO4 or Channel 5 = screw terminals 20 & 7 is configured as an output channel (5 VDC) in the CompassCDS software.

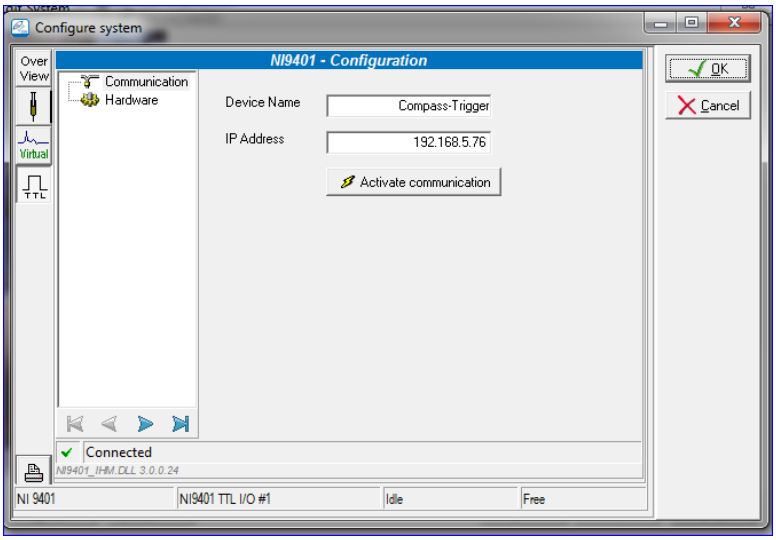


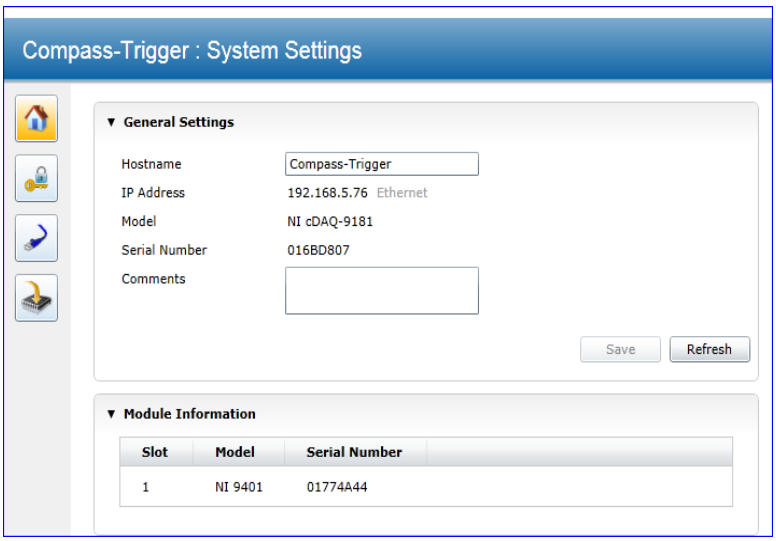

Example NI-9401 input and output connection configurations are shown below.

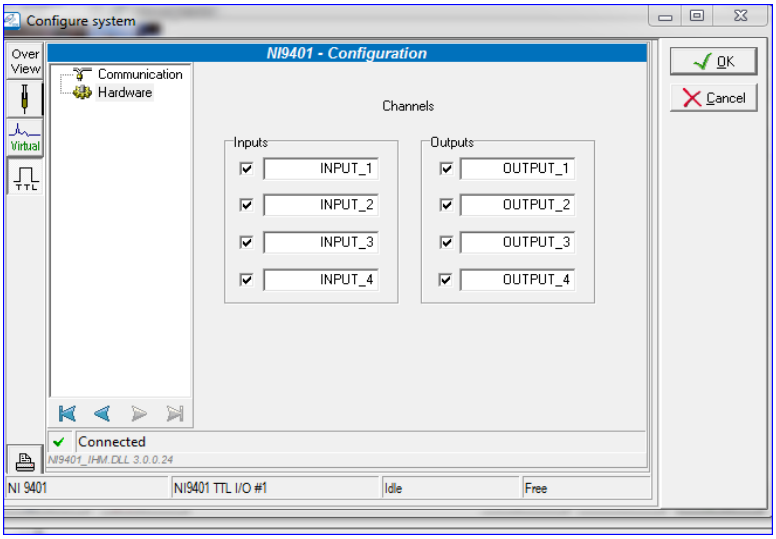


# Configuring the NI-9401 TTL I/O Module

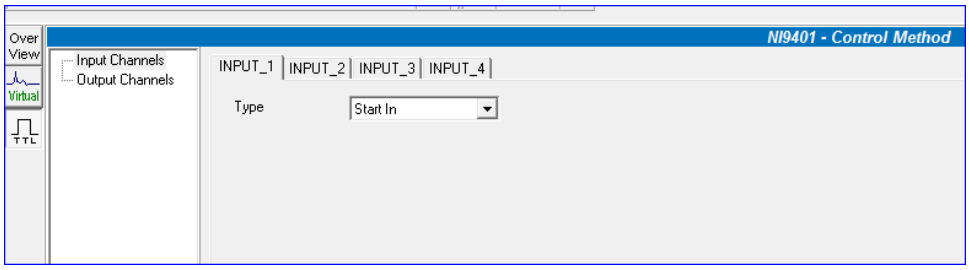
The NI-9401 TTL I/O module is configured within CompassCDS from the Config Manager. Users should click on this tab and then the Hardware field, selecting the National Instruments option from the dropdown list as shown below. The NI-9181 module IP address should be entered in the Address box and the Activate Communication button clicked. The Hostname will appear along with the 9401 graphical user interface (GUI) below the hostname. The Device Status should indicate *Connected***.** The user can now select either the Input or the Output option. The timetable can be used to set up complex I/O triggering if this is required.

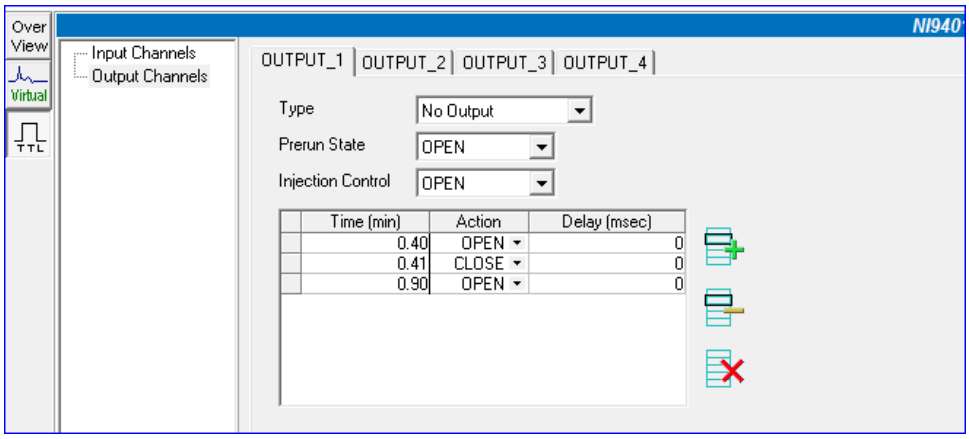





Once the TTL I/O device has been set up in Config Manager, the only additional setting is located within the CompassCDS method where the user has to select the Input or Output sections as shown below. Once the method is saved and Services are stopped and started, TTL I/O triggering will be active.



# NI Hardware Technical Specifications

## NI-9181 Chassis

| | |
|---|---|
| Network Protocols | TCIP, UDP |
| Network ports used | HTTP:80 (configuration only)<br>TCP:3580<br>UDP:5353 (configuration only)<br>TCP:5353 (configuration only)<br>TCP:31415<br>UDP:7865 (configuration only)<br>UDP:8473 (configuration only) |
| Network IP configuration | DHCP + Link-Local, DHCP, Static, Link-Local |
| Network interface | |
| NI cDAQ-9181 | 100 Base-TX, full-duplex<br>100 Base-TX, half-duplex<br>10 Base-T, full-duplex<br>10 Base-T, half-duplex |
| Communication rates | |
| NI cDAQ-9181 | 10/100 Mbps, auto-negotiated |
| Maximum cabling distance | 100 m/segment |

Input/output voltage protection

| Voltage | Minimum | Maximum |
|---|---|---|
| Input | –20 V | 25 V |
| Output | –15 V | 20 V |

Maximum operating conditions[1]

| Level | Minimum | Maximum |
|---|---|---|
| $I_{OL}$ output low current | — | 8 mA |
| $I_{OH}$ output high current | — | –8 mA |

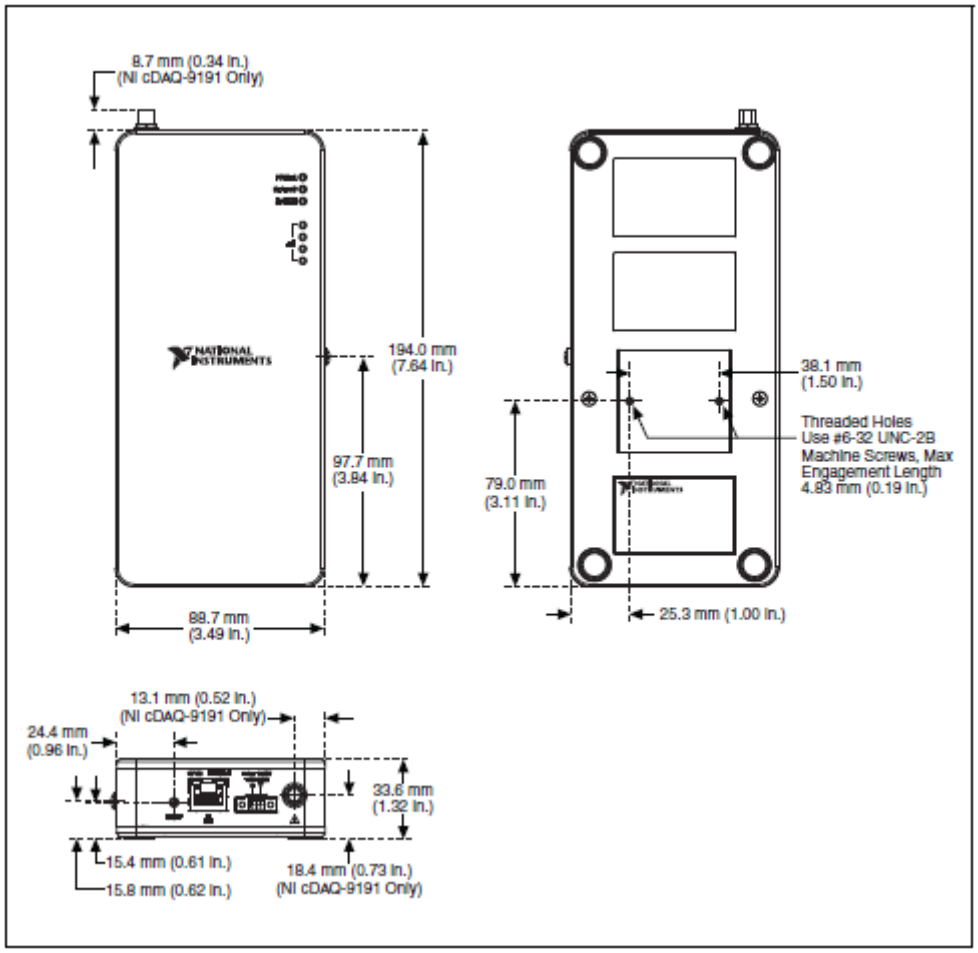
DC input characteristics

| Level | Minimum | Maximum |
|---|---|---|
| Positive going threshold | 1.43 V | 2.28 V |
| Negative going threshold | 0.86 V | 1.53 V |
| Hysteresis | 0.48 V | 0.87 V |

DC output characteristics

| Level | Conditions | Minimum | Maximum |
|---|---|---|---|
| High | — | — | 5.25 V |
| | Sourcing 100 µA | 4.65 V | — |
| | Sourcing 2 mA | 3.60 V | — |
| | Sourcing 3.5 mA | 3.44 V | — |
| Low | Sinking 100 µA | — | 0.10 V |
| | Sinking 2 mA | — | 0.64 V |
| | Sinking 3.5 mA | — | 0.8 V |

| | |
|---|---|
| Voltage input range | 9 to 30 V |
| Maximum required input power | |
| NI cDAQ-9181 | 5 W |
| Weight (unloaded) | Approx. 470 g (16.6 oz) |
| Dimensions (unloaded) | 194.0 × 88.7 × 33.6 mm (7.64 × 3.49 × 1.32 in.) |




| | |
|---|---|
| Operating Temperature<br>(IEC-60068-2-1 and IEC-60068-2-2)<br>NI cDAQ-9181/9191 | 0 to 55 °C |
| Storage Temperature<br>(IEC-60068-2-1 and IEC-60068-2-2)<br>NI cDAQ-9181/9191 | –10 to 70 °C |
| Ingress protection | IP 30 |
| Operating Humidity (IEC-60068-2-56) | 10 to 90% RH, noncondensing |
| Storage | 5 to 95% RH, noncondensing |
| Pollution Degree (IEC 60664) | 2 |
| Maximum altitude | 5,000 m |
| Operational shock | 30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. |

This module meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

## NI-9481 Relay Module

The following specifications are typical for the range –40 to 70 °C unless otherwise noted.

### Output Characteristics

| | |
|---|---|
| Number of channels | 4 electromechanical relay channels |
| Relay type | Single pole single throw (SPST) |
| Power-on output state | Channels off |
| Switching capacity (resistive load) | |
| Switching voltage | 60 VDC max, 250 Vrms max |
| Switching current, per channel | |
| One channel on | 4 A max at 30 VDC, 1 A max at 60 VDC, 4 A max at 250 Vrms |
| All channels on | 2 A max at 30 VDC, 1 A max at 60 VDC, 2 A max at 250 Vrms |
| Resistance per channel, channel on | 50 mΩ |
| Switching rate | 1 operation per second |
| Relay release time | 5 ms max |
| Relay operate time | 10 ms max |
| Relay bounce time | 3 ms |
| Off state leakage | 10 µA max |
| Life expectancy | |
| Mechanical (no load) | 20,000,000 operations |
| Electrical (connecting to load) | 100,000 operations |

### Power Requirements

| | |
|---|---|
| Power consumption from chassis | |
| Active mode | 580 mW max |
| Sleep mode | 5 mW max |
| Thermal dissipation (at 70 °C) | |
| Active mode | 1.5 W max |
| Sleep mode | 5 mW max |
| Screw-terminal wiring | 12 to 24 AWG copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end |
| Torque for screw terminals | 0.5 to 0.6 Nm (4.4 to 5.3 lb in.) |
| Ferrules | 0.25 mm2 to 2.5 mm2 |
| Weight | 150 g (5.3 oz) |

## Safety Voltages

Connect only voltages that are within the following limits.

| | |
|---|---|
| CHa-to-CHb | 250 Vrms max, Measurement Category II |

## Hazardous Locations

| | |
|---|---|
| U.S. (UL) | Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4 |

## Safety Standards

This module meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

## Electromagnetic Compatibility

This module meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

## CE Compliance

This product meets the essential requirements of applicable European Directives:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

### Shock and Vibration

| | |
|---|---|
| Operating vibration, sinusoidal (IEC 60068-2-6) | 5 g, 40 to 500 Hz; 0.062 in., double amplitude, 10 to 40 Hz |

### Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure.

| | |
|---|---|
| Operating temperature (IEC 60068-2-1, IEC 60068-2-2) | –40 to 70 °C |
| Storage temperature (IEC 60068-2-1, IEC 60068-2-2) | –40 to 85 °C |
| Ingress protection | IP 40 |

| | |
|---|---|
| Operating humidity (IEC 60068-2-56) | 10 to 90% RH, noncondensing |
| Storage humidity (IEC 60068-2-56) | 5 to 95% RH, noncondensing |
| Maximum altitude | 2,000 m |
| Pollution Degree (IEC 60664) | 2 |

## NI-9401 TTL I/O Module

The following specifications are typical for the range –40 to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

### Input/Output Characteristics

| | |
|---|---|
| Number of channels | 8 DIO channels |
| Default power-on line direction | Input |
| Input/output type | TTL, single-ended |

### Digital logic levels

#### Input

| | |
|---|---|
| Voltage | 5.25 V max |
| High, VIH | 2 V min |
| Low, VIL | 0.8 V max |

#### Output

| | |
|---|---|
| High, VOH | 5.25 V max |
| Sourcing 100 µA | 4.7 V min |
| Sourcing 2 mA | 4.3 V min |

#### Low, VOL

| | |
|---|---|
| Sinking 100 µA | 0.1 V max |
| Sinking 2 mA | 0.4 V max |
| I/O propagation delay | 100 ns max |
| I/O pulse width distortion | 10 ns typ |
| Input current (0 V ≤ Vin ≤ 4.5 V) | ±250 µA typ |
| Input capacitance | 30 pF typ |
| Input rise/fall time | 500 ns max |
| Overvoltage protection, channel-to-COM | ±30 V max on one channel at a time; however, continued use at this level will degrade the life of the module. |

### Power consumption from chassis

| | |
|---|---|
| Active mode | 580 mW max |
| Sleep mode | 1 mW max |

### Thermal dissipation (at 70 °C)

| | |
|---|---|
| Active mode | 580 mW max |
| Sleep mode | 1 mW max |
| Weight | 145 g (5.1 oz) |

## Safety Standards

This module is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

## Hazardous Locations

| | |
|---|---|
| U.S. (UL) | Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4 |
| Canada (C-UL) | Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nC IIC T4 |
| Europe (DEMKO) | EEx nC IIC T4 |

## Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure.

| | |
|---|---|
| Operating temperature (IEC 60068-2-1, IEC 60068-2-2) | –40 to 70 °C |
| Storage temperature (IEC 60068-2-1, IEC 60068-2-2) | –40 to 85 °C |
| Ingress protection | IP 40 |
| Operating humidity (IEC 60068-2-56) | 10 to 90% RH, noncondensing |
| Storage humidity (IEC 60068-2-56) | 5 to 95% RH, noncondensing |
| Maximum altitude | 2,000 m |
| Pollution Degree (IEC 60664) | 2 |

## Operating vibration

| | |
|---|---|
| Random (IEC 60068-2-64) | 5 grms, 10 to 500 Hz |
| Sinusoidal (IEC 60068-2-6) | 5 g, 10 to 500 Hz |
| Operating shock (IEC 60068-2-27) | 30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations |

## Electromagnetic Compatibility

This module is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

## CE Compliance

This module meets the essential requirements of applicable European directives, as amended for CE markings, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)